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(54) Handle Shaft for a Hockey Stick and Method and Tool for Fabrication Thereof

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Abstract

A handle shaft for a hockey stick and method and tool for fabrication of the shaft. The shaft is constructed of fiber-reinforced thermosetting plastic into a hollow, oval tube by alternately laminating upon a rather flat mandrel longitudinal and crosswise wound fiber layers, moistened with a binder resin. More longitudinal fibers are laminated on broad sides of a shaft. The base of a mandrel is vigorously flattened.

Handle shaft for a hockey stick and method and tool for fabrication thereof.

The present invention relates to a hockey stick handle shaft, in which is used a fiber-reinforced thermosetting plastic and whose cross-section is other than circular. The reinforcement used is preferably glass or carbon fiber. The invention also relates to a method for continuous fabrication of a hockey stick shaft from a fiber-reinforced thermosetting plastic. The invention also relates to a tool for embodying the method.

At present, the hockey stick shafts are constructed almost exclusively of wood by gluing and pressing wood slivers together. However, wooden handle shafts are hampered by several drawbacks. The shafts fracture and break easily which is why hockey sticks must be fabricated in large quantities and it is also necessary to carry large quantities of spare sticks on match tours. Another drawback is that, due to the inhomogeneity, glueing, and other such material and manufacturing factors of wood material, the sticks are always different from each other, especially for their stiffness. This drawback deteriorates during the use of hockey sticks, since in stress situations, critical bonds inside a stick snap and the stick becomes increasingly more resilient. This stiffness variation of sticks leads to certain inaccuracy in shots. In addition, the resiliency characteristics of wood are poor, i.e. the attenuation equivalent of wood is relatively high, which means that the deflection energy, involved in straightening the shaft that bends in connection with a slapshot directed to the puck, is badly recovered for a higher initial velocity. A third drawback is the relatively great weight of a wooden stick since the core material of a solid hockey stick is essentially unnecessary in terms of stiffness. For reasons of fabrication technique, a wooden shaft is of equal material over its entire length. A result of this is that the shaft most often breaks at its base portion below the player's lower hand.

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The natural form of cross-section of a laminated product glued of wood slivers is a rectangle. The corners of said rectangle are removed because of safety hazard. However, the design of a shaft is still angular which in practice has still been found to be a substantial safety hazard. For example, there have been incidents that a finger squeezing the shaft has broken against a shaft corner in a hard stress.

There is a prior proposal for the increased strength of a hockey stick handle shaft (US Patent 3 561 760) that the shaft be constructed of fiberglass-reinforced platics. The core portion of a shaft is comprised of foam plastic upon which is laminated said fiberglass-reinforced plastic. The foam plastic inside the shaft has been required for reasons of fabrication technique to provide a core upon which a fiberglass-reinforced plastic sheeting is formed. Nevertheless, the foam plastic core increases the weight of a shaft without any substantial contribution to its strength. Such a shaft cannot be fabricated by a continuous process but production is mostly manual. This is why the proposed hockey stick will be too expensive to be competitive with sticks fitted with a wooden shaft.

An object of the invention is to provide a handle shaft for a hockey stick constructed of a fiber-reinforced plastic and producible in continuous process by means of an automatic machine, the price of a shaft becoming approximately the same as that of a wooden shaft while gaining the above-mentioned advantages over a wooden shaft.

In order to achieve this object, the hockey stick shaft according to the invention comprises a hollow tube, including partly longitudinal and partly transverse fibers wound therearound. Such a shaft can be manufactured by a continuous process in a manner that successively conveyed mandrels of rather flat cross-section are laminated by alternately winding longitudinal and crosswise fiber layers therearound, that after setting of a binder the obtained tube is cut to lengths between said mandrels and the mandrels are removed from inside the tubes and re-fed into

the production machine.

The tool employed comprises a metal mandrel of rather flat cross-section whose one end is flattened the same way as the tip of a chisel. Thus, the base of a shaft will be accordingly flat for fastening it to the blade.

The flexural rigidity of a shaft is accomplished ~~accomplised~~ mainly by means of longitudinal fibers and the impact strength and resistance to buckling are mainly achieved by means of cross-fibers.

An essential aspect in the construction of the invention and its fabrication is a possibility of selecting the fiber distribution in an optimum manner in terms of strength.

In order to increase the flexural rigidity without the increase in weight, the invention suggests that the distribution of longitudinal fibers in various parts of cross-section be varied in a manner that most longitudinal fibers lie on those opposite sides whose relative distance across the central axis of a shaft is the shortest.

Also the number of cross-fibers per unit length ~~unit~~ of a shaft can be varied by controlling the number of wound cross-fibers by means of a programmable logic. Thus, the base portion of a shaft below the player's lower hand can be provided with more cross-fiber wound therearound.

In terms of the optimization of strength, it is essential that the number of longitudinal fibers is substantially more than that of cross-fibers. Cross-fibers are interposed between the longitudinal fiber layers.

A hockey stick shaft of the invention offers the following advantages.

A shaft stronger than those of wooden sticks will be more economic since the number of shafts broken is less than before.

The shaft can be made sufficiently strong and at the same time it is lighter than the prior art shafts.

The fiber-reinforced plastic shaft construction returns the deflection energy better, so the puck will acquire a higher initial velocity at the same force.

It is also possible to manufacture shafts of exactly equal stiffness which also retain their stiffness in use, i.e. the fatigue inherent of wooden shafts will not occur. With such a shaft, the player learns better shooting accuracy.

The cross-section of a hockey stick can be made oval, contributing on one hand to a grip (the stick does not turn in the hands) and, on the other hand, hazardous corners are eliminated, so the shaft is safer to its users.

The invention will now be described in more detail with reference made to the accompanying drawings, in which:

FIG. 1 shows a hockey stick in side view and

FIG. 2 is a cross-section of a stick shaft in one preferred embodiment of the invention.

FIG. 3 is a double side and end view of mandrel upon which the shaft is fabricated.

The innermost layer 1 in the cross-section shown in Fig. 2 comprises glass fibers extending longitudinally of a shaft. A crosswise fiberglass layer 2 is wound therearound. Upon the latter there is another layer 3 of longitudinal glass fibers. A fourth layer 4 counting from inside comprises again a crosswise wound fiberglass layer and the outermost layer 5 is a longitudinal fiberglass layer. A tape can still be wound around the surface of a shaft.

The shaft fabrication is effected by a continuous process, wherein rather flat cross-sectioned mandrels 6, shown e.g. in fig. 3, are conveyed successively, spaced a small distance from each other. Longitudinal and crosswise fiber layers are laminated alternately upon said mandrels. Longitudinal fibers are passed through fairleads by means of which the longitudinal fiber distribution in various parts of cross-section is obtained as desired. For increased flexural rigidity, the broad sides of a shaft are provided with more longitudinal fibers.

The number of cross-fibers to be wound is controlled by means of a logic in a manner to provide a desired amount of cross-fiber in various sections of the shaft length. It is particularly plausible to wind more cross-fiber on the base portion of a shaft, below the player's lower hand.

For each longitudinal fiber layer and cross-fiber layer are provided successive fiber supply stations, wherein the resin-moistened fibers are passed around a mandrel.

In order to make the base of a shaft flat for attachment to the blade, one end of a mandrel is flattened the same way as the tip of a chisel, as shown in fig. 3.

When all fiber layers have been fabricated upon a moving array of mandrels and when a binder has set as catalyzed by heat, the tube is cut to lengths at points between said mandrels, the latter are removed from inside the tubes and re-fed into the machine.

In the case shown in fig. 2, the external shape of a mandrel would have been oval. However, in terms of steering a mandrel, the rather flat polygonal shape is preferred. Even in this case, the outer surface of a shaft can be made completely oval by properly controlling the distribution of longitudinal fibers.

In continuous fabrication, the mandrels are required in large quantities and they must withstand successive re-runs. This is one of the reasons why metal mandrels are employed in the invention.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A handle shaft for a hockey stick, said handle shaft being constructed along a longitudinal axis for forming an elongated hollow tube which is non-circular in transverse cross-section, said hollow tube having an inner surface and an outer surface, said inner surface comprising a first layer formed of a plurality of resin-bonded fibers, said first layer being encased within successive layers of resin-bonded crosswise extending fibers and resin-bonded longitudinally extending fibers.

2. A handle shaft as defined in claim 1 wherein said shaft includes a handle portion and a base portion, said base portion being flattened to provide attachment means for attaching said shaft to a hockey stick blade.

3. A handle shaft as defined in claim 1 wherein the number of longitudinally extending fibers is substantially more than the number of crosswise extending fibers.

4. A handle shaft as defined in claim 1 wherein said first layer is formed of longitudinally extending fibers.

5. A handle shaft as defined in claim 1 wherein said transverse cross-section is generally oval and said shaft includes opposed side surfaces and opposed end surfaces, said opposed side surfaces being spaced from said longitudinal axis a shorter distance than are said end surfaces, and said side surfaces contain more long-

itudinally extending fibers than said end surfaces.

6. A handle shaft as defined in claim 1 wherein the number of said crosswise extending fibers per unit length varies in various sections of said shaft.

7. A handle shaft as defined in claim 1 wherein said shaft includes a handle portion and a base portion, and said base portion contains more crosswise extending fibers per unit length than said handle portion.

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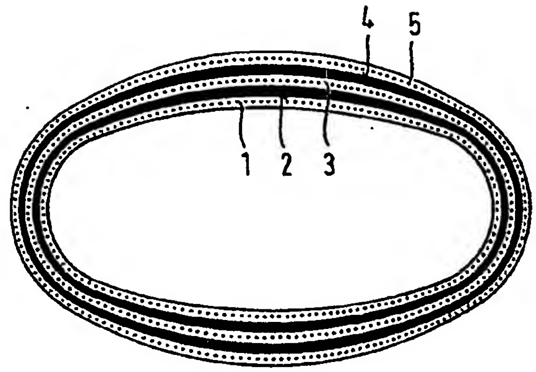

Fig. 2

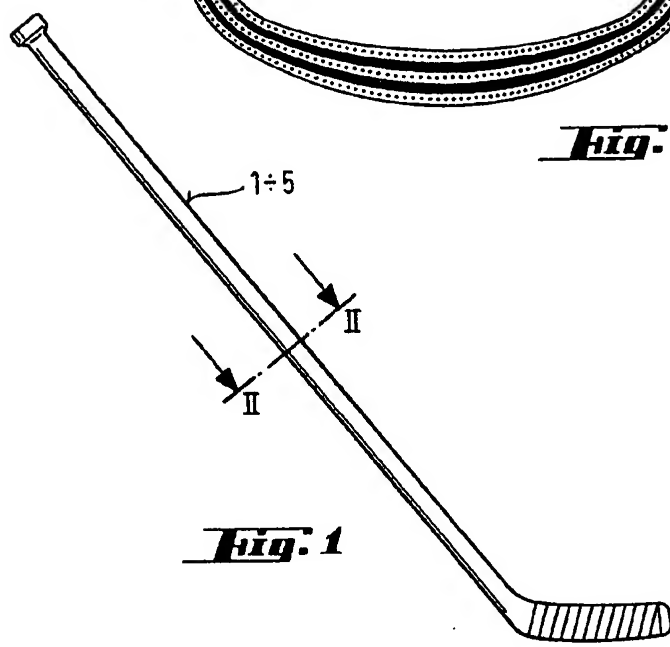

Fig. 1

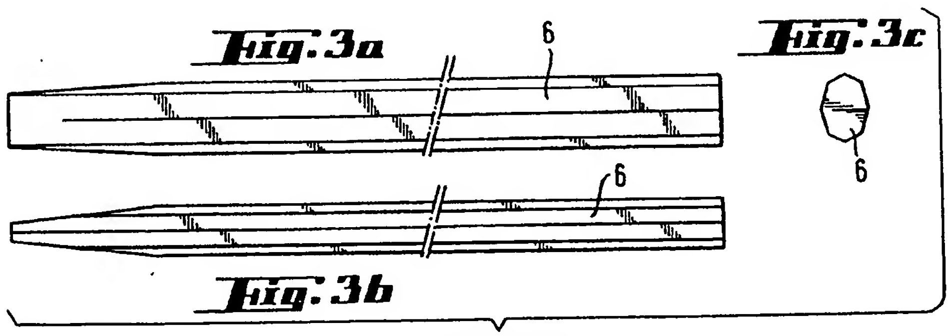

Fig. 3

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